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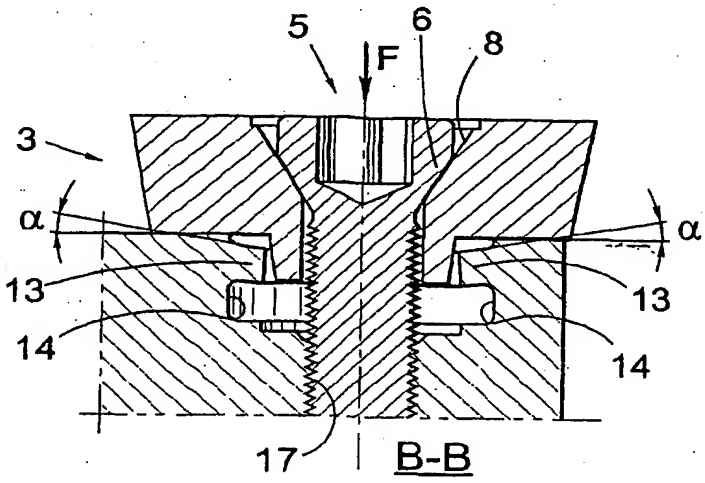
(54) Tool for chip-removing machining

(57) The present invention relates to a tool for chip-removing machining, the tool comprising an insert holder, a cutting insert (3) for chip-removing machining, the cutting insert (3) having a male part, and members (5) for fixing the cutting insert (3) in a insert seat of the insert holder. The invention also relates to the cutting insert separately and to the insert holder separately.

Characteristic of the tool according to the present invention is that the insert seat has a number of flexible portions (13), that first plane contact surfaces are arranged on the male part and that second plane contact surfaces are arranged adjacent to the flexible portions (13), and that the first contact surfaces will get in to abutment against the second contact surfaces when the cutting insert (3) is mounted in the insert seat.

Fig. 7



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Description

Technical Field of the Invention

[0001] The present invention relates to a tool for chip-removing machining, the tool comprising an insert holder, a cutting insert for chip-removing machining and members to fix the cutting insert in an insert seat of the insert holder. The invention also relates to the cutting insert separately and to the insert holder separately.

Prior Art

[0002] A tool coupling is previously known from WO 01/87523 A1, a tool for chip-removing machining according to the preamble defined above being previously known according to an embodiment disclosed in this document. Thereby, a cutting insert for chip-removing machining included in the tool is also previously known and an insert holder included in the tool is previously known. The cutting insert for chip-removing machining has on the bottom side thereof a male part and the insert holder has a female part corresponding to the male part. The male part comprises a number of teeth having both axial and radial extension. The female part comprises a number of recesses, which are designed to receive the teeth of the male part. In general, both the male part and the female part may be conical.

Objects and Features of the Invention

[0003] A primary object of the present invention is to provide a tool of the kind defined above, as well as the cutting insert included in the tool and the insert holder included in the tool, whereby the fixation of the cutting insert in the insert holder should be extraordinarily stable. In this connection, it is particularly important that the cutting insert can withstand forces which are changeable and acting from different directions and that the fixation is not materially affected by shifting temperatures that may occur during true working conditions.

[0004] Another object of the present invention is to use such materials in the insert holder and the cutting insert that the properties of the materials are optimally utilized.

[0005] At least the primary object of the present invention is realised by means of a tool of the kind defined above that exhibit the features defined in the independent claim 1. Other independent claims define the features of the cutting insert for chip-removing machining and the insert holder. Preferred embodiments of the tool, the cutting insert and the insert holder are defined in the dependent claims.

Brief Description of the Drawings

[0006] Below, a number of embodiments of the invention will be described with reference to the appended drawings, where:

- Fig 1 shows an exploded view in perspective of a tool according to the present invention;
- Fig 2 shows a perspective view from below of the cutting insert for chip-removing machining included in the tool;
- Fig 3 shows a perspective view obliquely from above of the insert seat of the insert holder included in the tool according to the present invention;
- Fig 4 shows a plane view of the insert seat according to Fig 3;
- Fig 5 shows a section along A-A of Fig 4;
- Fig 6 shows a plane view of the part of the tool where the cutting insert is received in the insert holder;
- Fig 7 shows a section along B-B of Fig 6;
- Fig 8 shows an exploded view in perspective of a first alternative embodiment of the tool according to the present invention;
- Fig 9 shows a perspective view of the tool according to Fig 8 when the cutting insert is mounted in the insert holder;
- Fig 10 shows an exploded view in perspective of a second alternative embodiment of the tool according to the present invention;
- Fig 11 shows a perspective view of the tool according to Fig 10 when the cutting insert is mounted in the insert holder;
- Fig 12 shows an exploded view in perspective of a third alternative embodiment of the tool according to the present invention; and
- Fig 13 also shows an exploded view in perspective of the tool according to Fig 12, the parts included in the tool being oriented in mounting position.

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Detailed Description of Preferred Embodiments of the Invention

[0007] In Fig 1, an exploded view of a tool according to the present invention is shown. Thus, the tool comprises an insert holder 1, a cutting insert 3 for chip-removing machining and members for fixation, in the form of a locking screw 5, in order to fix the cutting insert 3 in a insert seat 7 of the insert holder 1. The locking screw 5 has a conical head 6. A common centre axis for the locking screw 5, the cutting insert 3 and the insert seat 7 is designated C-C in Fig 1.

[0008] As may be seen in Figs 1 and 2, the cutting insert 3 for chip-removing machining has a through first hole 2 for receipt of the locking screw 5. The cutting insert 2 is provided with a male part 9 at the bottom side thereof, which is formed integrally with a cutting body 4 of the cutting insert 3. The male part 9 comprises a number of fingers 10 extending radially from the centre of the cutting insert 3, the number of fingers 10 in the embodiment shown being six. A number of first recesses 11 are defined between the fingers 10, which also are included in the male part 9. The fingers 10 and the first recesses 11 have a certain axial extension in the longitudinal direction of the centre axis C-C. First plane contact surfaces 12 are formed on the fingers 10, at the transition to an adjacent first recess 11, which thus are situated on surfaces generally having both radial and axial extension in relation to the centre axis C-C. In the embodiment illustrated, each finger 10 of the male part 9 generally has a form tapering in the direction from the cutting body 4 and the first plane contact surfaces 12 arranged on one and the same finger 10 converge towards each other in the direction from the cutting body 4. Correspondingly, each first recess 11 has a generally widening form in the direction from the cutting body 4.

[0009] The insert seat 7 illustrated in detail in Fig 3 comprises a number of flexible portions 13 extending towards the centre of the insert seat 7, which portions are defined by the bottom side of the flexible portions 13 having a notch 14 formed therein, see Figs 5 and 7 especially, in the insert seat 7. The flexible portions 13 amount to six. Between the flexible portions 13, a number of second recesses 15 are defined, which also amount to six. In the area of the free ends thereof, the flexible portions 13 are provided with second plane contact surfaces 16, which are arranged on the portions of the flexible portions 13 that have a generally radial extension. The flexible portions 13 and the second recesses 15 have a certain extension in the axial direction in the longitudinal direction of the centre axis C-C, whereby the axial extension of the fingers 10 and the flexible portions 13 do not need to be equal.

[0010] In general, the second recesses 15 has a tapering form in the direction into the insert seat 7 and the second plane contact surfaces 16, arranged in opposite pairs adjacent to the transition between the flexible portions 13 and the second recesses 15, converge towards each other in the direction into the insert seat 7.

[0011] The insert seat 7 is also provided with an internally threaded second hole 17, which is intended to receive the externally threaded portion of the locking screw 5.

[0012] On mounting of the cutting insert 3 in the insert holder 1, the male part 9 of the cutting insert 3 is brought to be received in the insert seat 7, the fingers 10 of the male part 9 being received in the second recesses 15 of the insert seat 7. In that connection, the first and second contact surfaces 12 and 16 are placed in such a way that they will abut against each other when the cutting insert 3 is mounted in the insert seat 7. Now the locking screw 5 is introduced into the first hole 2 of the cutting insert 3, the externally threaded portion of the locking screw 5 being received in the internally threaded second hole 17 of the insert holder 1. On tightening of the locking screw 5, the conical head 6 of the locking screw 5 will come into abutment against a conical contact surface 8 of the cutting insert 3, see Fig 7. On continued tightening of the locking screw 5, the cutting insert 3 will become affected by an axially directed force F, which will bring the cutting insert 3 to be displaced in the direction towards the insert seat 7. By means of the tapering form of the fingers 10 and the interacting widening form of the second recesses 15, the first and second contact surfaces 12 and 16, respectively, will come to mutual abutment. The displacement of the cutting insert 3 in the direction towards the insert seat 7 implies that the fingers 10 also are displaced in the corresponding direction. The mutual abutment of the contact surfaces 12 and 16 also entails that the flexible portions 13 are given a corresponding displacement/deflection, i.e. in the direction towards the second hole 17. This displacement of the flexible portions 13 is made possible by the notch 14, which gives the flexible portions 13 a certain flexibility. The deflection of the flexible portions 13 is illustrated in Fig 7, where the deflection is symbolised by the angle α that the upper surfaces of the flexible portions 13 form with a contact surface 18 radially outside of the second recesses 15. In reality $0°30' < \alpha < 12°$. As is seen in Fig 7, the bottom side of the cutting insert 3 will abut against the contact surface 18, which in combination with the mutual abutment between the contact surfaces 12 and 16 guarantees an extraordinary good fixation of the cutting insert 3 in the insert holder 1.

[0013] In the first alternative embodiment of a tool according to the present invention illustrated in Fig 8, the tool comprises an insert holder 101, a triangular cutting insert 103 for chip-removing machining and members for fixation 105 to fix the cutting insert 103 in a insert seat 107 in the insert holder 101. The members for fixation 105 in this embodiment comprise a clamp 120 and a locking screw 121, by means of which the clamp 120 is fixed in relation to the insert holder 101 by the locking screw 121 being received in a through third hole 122 of the clamp 120 and in a threaded fourth hole 123 of the insert holder 101.

[0014] As may be seen in Fig 8, the cutting insert 103 comprises a male part 109, which is attached to the bottom

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side of the cutting insert 103. In the embodiment illustrated, the male part 109 comprises three fingers 110, the fingers 110 between themselves defining an angle that preferably is equally large for all fingers 110. On the limiting surfaces of the fingers 110 that generally have an extension in both radial and axial direction in relation to the centre axis C-C, first plane contact surfaces 112 are arranged. The fingers 110 are of a generally tapering shape in the direction from the cutting body 104. This implies that the first plane contact surfaces 112 is arranged on one and the same finger 110 are not parallel but converge towards each other in direction from the cutting body 104.

[0015] The insert seat 107 comprises a number of flexible portions 113, which are defined by a notch 114 being formed on the bottom side of the portions 113, which notch is of principally the same design as the above-described notch 14. The flexible portions 113 amount to three. Between the flexible portions 113, a number of second recesses 115 are defined, which also amount to three. In the transition between the flexible portions 113 and the second recesses 115, second plane contact surfaces 116 are arranged, which thus are arranged on the parts of the flexible portions 113 that generally have an extension both in radial direction and axial direction in relation to the centre axis C-C of the insert seat 107. The second plane contact surfaces 116 are generally opposite each other in pairs, said opposite, plane second contact surfaces 116 not being parallel to each other but converge towards each other in direction into the insert holder 101. The flexible portions 113 and the second recesses 115 have a certain extension in axial direction in relation to the centre axis C-C, whereby the axial extension of the fingers 110 and the flexible portions 113 does not need to be equal.

[0016] At mounting of the cutting insert 103 in the insert seat 107, see Fig 9, the fingers 110 are received in the second recesses 115, whereby the first plane contact surfaces 112 of the male part 109 come in abutment against the second plane contact surfaces 116 of the insert seat 107. The reason for contact being established between said surfaces 112, 116 is that they converge in the same direction. On clamping the cutting insert 103 in the insert holder 101, this is carried out by means of the members for fixation 105 that comprise a clamp 120 and a locking screw 121. In that connection, the cutting insert 103 with the integrated male part 109 thereof will be pushed further into the insert seat 107, the abutment pressure between the contact surfaces 112 and 116 increases. When the clamping force that acts on the cutting insert 103 is large enough, a displacement/deflection of the flexible portions 113 will take place in a manner corresponding to that described above for the embodiment according to Figs 1-7. In that connection, the bottom side of the cutting insert 103 will come in abutment against the insert holder 101 and an extraordinarily good fixing of the cutting insert 103 is obtained.

[0017] In the second alternative embodiment of a tool according to the present invention illustrated in Figs 10 and 11, it may be seen that the cutting insert 203 included in the tool at the bottom side thereof is provided with a male part 209 that comprises two diametrically arranged fingers 210 and generally circular centre portion 225. In the embodiment illustrated, the fingers 210 and the centre portion 225 are made integrally with the cutting body 204. The fingers 210 and the centre portion 225 are mutually likewise formed in one piece. The cutting insert 203 has a central through first hole 202. On the limiting surfaces of the fingers 210 that generally have an extension both in the radial and axial direction in relation to the centre axis C-C, first plane contact surfaces 212 are arranged. The fingers 210 are of a generally tapering shape in direction from the cutting body 204. This means that the first plane contact surfaces 212 arranged on one and the same finger 210 are not parallel but converge towards each other in direction from the cutting body 204. Furthermore, in the embodiment according to Figs 10 and 11, third contact surfaces 226 are arranged on the limiting surfaces of the centre portion 225 which have an extension both in the axial and radial direction in relation to the centre axis C-C. Said third contact surfaces 226 are arranged in pairs diametrically in respect of the centre axis C-C and converge in pairs towards each other in direction from the cutting body 204. The third contact surfaces 226 are not plane but assume the shape of the centre portion 225, i.e. they are curved.

[0018] The insert seat 207 comprises two diametrically arranged second recesses 215, which are intended to receive the fingers 210, and two diametrically arranged third recesses 230, which are intended to receive parts of the centre portion 225 of the cutting insert 203. Between the recesses 215 and 230, the insert seat 207 has a number of flexible portions 213, which are defined by the insert seat 207 having a number of notches 214. On the free edges of the flexible portions 213, i.e. surfaces of both transversely and axially directed extension of the centre axis C-C, a number of second and fourth contact surfaces 216 and 217, respectively, are arranged. The second contact surfaces 216 are plane and generally opposite each other in pairs in the second recesses 215, whereby said opposite, plane second contact surfaces 216 are not parallel to each other but converge towards each other in direction into the insert holder 201. The fourth contact surfaces 217 are arranged in the central area of the insert seat 207. Said fourth contact surfaces 217 are not plane but have a shape adapted to the third contact surfaces 226 as they are to interact with said contact surfaces 226.

[0019] On mounting the cutting insert 203 in the insert seat 207, see Fig 11, the fingers 210 are received in the second recesses 215 and parts of the centre portion 225 are received in the third recesses 230. The first plane contact surfaces 212 and the third contact surfaces 226 of the male part 209 will thereby get in to abutment against the second plane contact surfaces 216 and the fourth contact surfaces 217, respectively, of the insert seat 207. Principally, interaction between said contact surfaces takes place in the corresponding manner as described above in connection with

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the above-described embodiments. As a consequence of this interaction, a displacement/deflection of the flexible portions 213 will take place in a manner corresponding to that described for the embodiments according to Figs 1-9. In that connection, the bottom side of the cutting insert 203 will get in to abutment against the insert holder 201 and an extraordinary good fixing of the cutting insert 203 is obtained.

[0020] In the third alternative embodiment of the tool according to the present invention illustrated in Fig 12, the insert seat 307 has the form of a replaceable unit, which has a generally cylindrical external surface. The replaceable unit 307 may be mounted in and dismounted from the insert holder 301. In the embodiment according to Fig 12, this is accomplished by means of a locking pin 331, which is introduced into in a fifth hole 332 of the insert holder 301, the locking pin 331 interacting with a groove 333 in the periphery of the replaceable unit 307. In Fig 13 is shown how the replaceable unit 307 and the locking pin 331 are oriented in connection with the replaceable unit 307 should be mounted in the insert holder 301. The male part 309 of the cutting insert 303 principally has a design corresponding to the male part 9 of the cutting insert 3, however, the male part 309 comprises more fingers 310. As for the insert seat/the replaceable unit 307, this is of a design that in principle corresponds with the insert seat 7 of the insert holder 1, however, the replaceable unit 307 comprises more flexible portions 313. As for the function of the tool according to Figs 12 and 13, it principally corresponds with the function of the tool according to Figs 1-7, and therefore reference is made to relevant sections of the text above in the description.

Feasible Modifications of the Invention

[0021] According to a preferred embodiment, the male part 9; 109; 209; 309 of the cutting inserts 3; 103; 203; 303 included in the above-described tools is made from the same material as the cutting inserts, i.e. usually cemented carbide. This is appropriate as the male part 9; 109; 209; 309 in principle is exerted to compressive strains only. However, within the scope of the present invention, it may also be conceived that the male part 9; 109; 209; 309 is made from another material than the cutting body 4; 104; 204; 304, the male part 9; 109; 209; 309 and the cutting body 4; 104; 204; 304 being in a suitable manner mutually interconnected.

[0022] Generally, for all above described embodiments, the axial extension of the male part 9; 109; 209; 309 does not need to correspond with the axial extension of the flexible portions 13; 113; 213; 313.

[0023] As for the shape of the fingers 10; 110; 210; 310 of the male part and the shape of the second recesses 15; 115; 215 9; 109; 209; 309, these do not need to be mutually complementary. It is sufficient if the first plane contact surfaces 12; 112; 212; 312 and the second plane contact surfaces 16; 116; 216; 316 are mutually oriented in such a way that abutment between these surfaces is established when the cutting insert 3; 103; 203; 303 is mounted in the insert seat 7; 107; 207; 307.

List of Reference Designations

[0024]

1; 101; 201; 301	Insert holder
2; 202; 302	First hole
3; 103; 203; 303	Cutting insert
4; 104; 204; 304	Cutting body
5; 105; 205; 305	Members of fixation
6	Conical head
7; 107; 207; 307	Insert seat
8	Conical contact surface
9; 109; 209; 309	Male part
10; 110; 210; 310	Fingers
11	First recesses
12; 112; 212; 312	First plane contact surfaces
13; 113; 213; 313	Flexible portions
14; 114; 214; 314	Notch
15; 115; 215	Second recesses
16; 116; 216; 316	Second plane contact surfaces
17	Second hole
18	Contact surface
120	Clamp
121	Locking screw
122	Third hole

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123	Fourth hole
225	Centre portion
226	Third plane contact surfaces
230	Third recesses
331	Locking pin
332	Fifth hole
333	Groove

Claims

1. Tool for chip-removing machining, the tool comprising an insert holder (1; 101; 201; 301), a cutting insert(3; 103; 203; 303) for chip-removing machining, the cutting insert (3; 103; 203; 303) having a male part (9; 109; 209; 309), and members (5; 105; 205; 305) for fixing the cutting insert (3; 103; 203; 303) in a insert seat (7; 107; 207; 307) of the insert holder (1; 101; 201; 301), **characterized in that** the insert seat (7; 107; 207; 307) has a number of flexible portions (13; 113; 213; 313), that first plane contact surfaces (12; 112; 212; 312) are arranged on the male part (9; 109; 209; 309), that second plane contact surfaces (16; 116; 216; 316) are arranged adjacent to the flexible portions (13; 113; 213; 313), and that the first contact surfaces (12; 112; 212; 312) get in abutment against the second contact surfaces (16; 116; 216; 316) when the cutting insert (3; 103; 203; 303) is mounted in the insert seat (7; 107; 207; 307).

2. Tool according to claim 1, **characterized in that** the male part (9; 109; 209; 309) comprises fingers (10; 110; 210; 310), on which the first plane contact surfaces (12; 112; 212; 312) are arranged.

3. Tool according to claim 1 or 2, **characterized in that** contact surfaces (12; 112; 212; 312) arranged on one and the same finger (10; 110; 210; 310) converge towards each other in direction from a cutting body (4; 104; 204; 304) of the cutting insert (3; 103; 203; 303).

4. Tool according to any one or some of the preceding claims, **characterized in that** the second plane contact surfaces (16; 116; 216; 316) of the insert seat (7; 107; 207; 307) are arranged in pairs opposite of each other, and that these pairs of contact surfaces (16; 116; 216; 316) converge towards each other in direction into the insert holder (1; 101; 201; 301).

5. Tool according to any one or some of preceding claims, **characterized in that** the flexible portions (13; 113; 213; 313) are achieved by the insert seat (7; 107; 207; 307) having one or more notches (14; 114; 214; 314) on the bottom side of the flexible portions (13; 113; 213; 313).

6. Tool according to any one or some of preceding claims, **characterized in that** both the first plane contact surfaces (12; 112; 212; 312) and the second plane contact surfaces (16; 116; 216; 316) generally have an extension along a centre axis (C-C) of the tool.

7. Tool according to any one or some of preceding claims, **characterized in that** the insert seat consists of a replaceable element (307).

8. Cutting insert for chip-removing machining, which comprises a cutting body (4; 104; 204; 304) and a male part (9; 109; 209; 309) protruding from the cutting body (4; 104; 204; 304), **characterized in that** the male part (9; 109; 209; 309) is provided with first plane contact surfaces (12; 112; 212; 312).

9. Cutting insert according to claim 8, **characterized in that** the male part (9; 109; 209; 309) comprises fingers (10; 110; 210; 310), on which the first plane contact surfaces (12; 112; 212; 312) are arranged.

10. Cutting insert according to claim 9, **characterized in that** contact surfaces (12; 112; 212; 312) arranged on one and the same finger (10; 110; 210; 310) converge towards each other in direction from the cutting body (4; 104; 204; 304) of the cutting insert (3; 103; 203; 303).

11. Insert holder (1; 101; 201; 301) comprising a insert seat (7; 107; 207; 307) for receipt of a cutting insert (3; 103; 203; 303) for chip-removing machining, **characterized in that** the insert seat (7; 107; 207; 307) has a number of flexible portions (13; 113; 213; 313), and that second plane contact surfaces (16; 116; 216; 316) are arranged

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adjacent to the flexible portions (13; 113; 213; 313).

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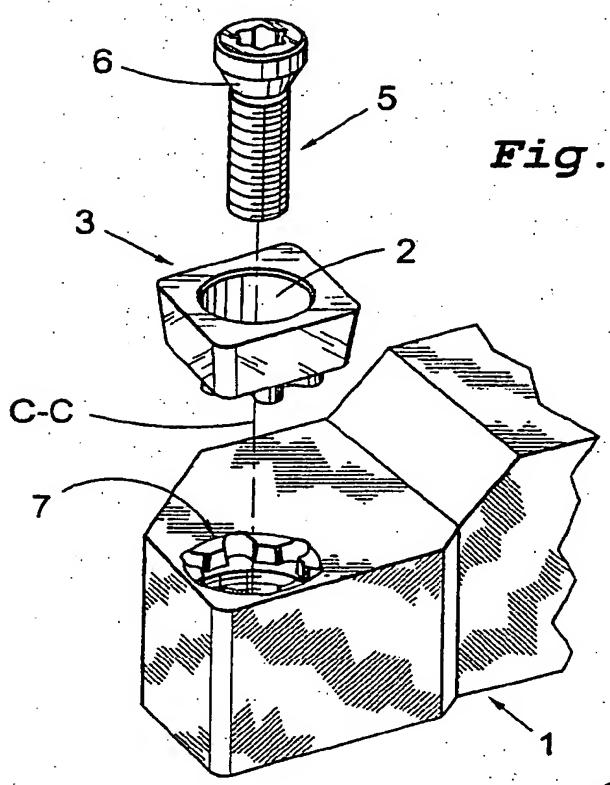

Fig. 1

Fig. 2

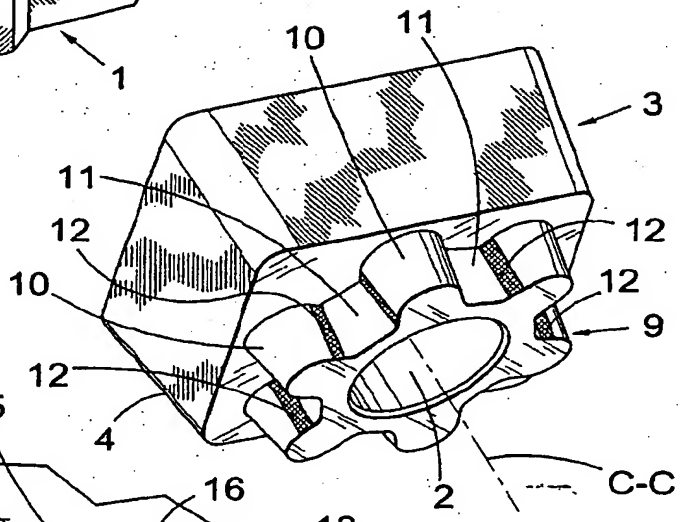

Fig. 3

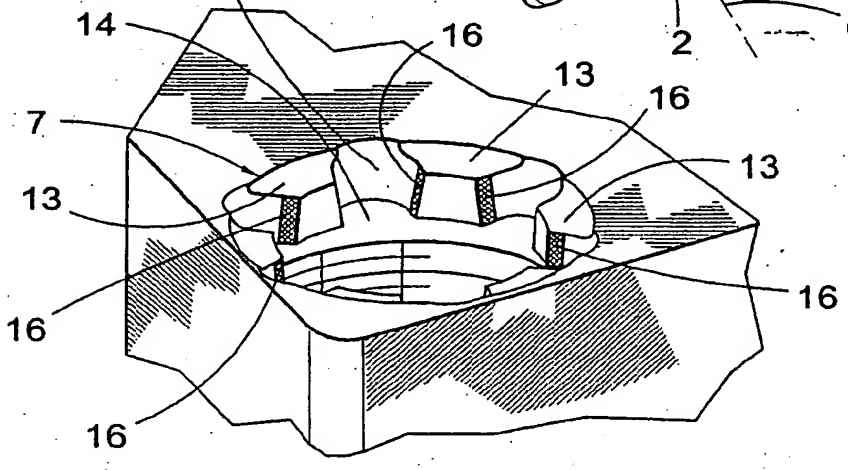

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Fig. 4

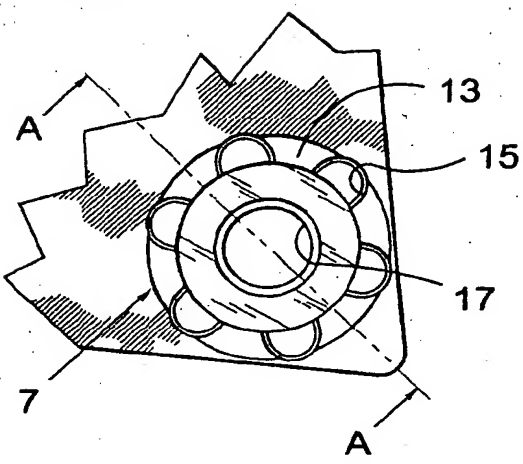


Fig. 5

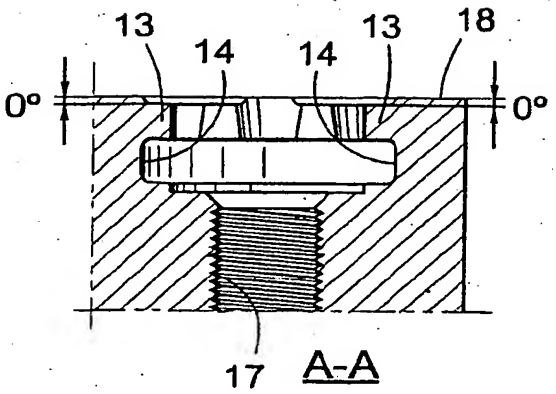


Fig. 6

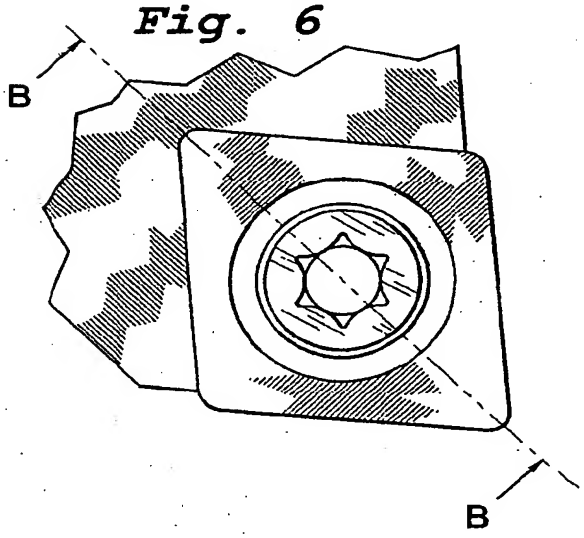
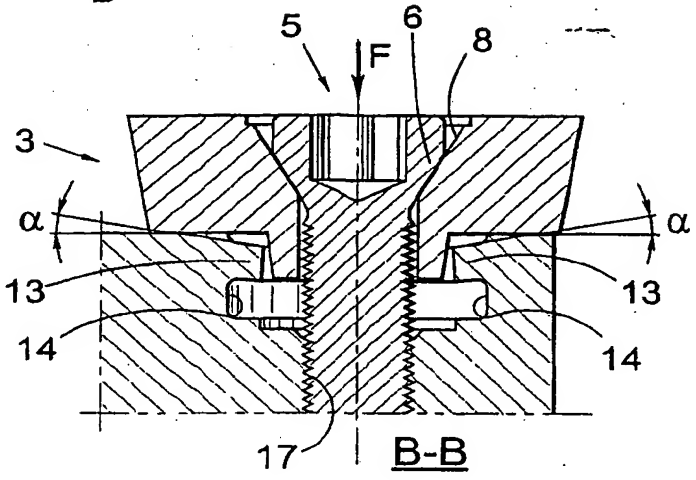


Fig. 7



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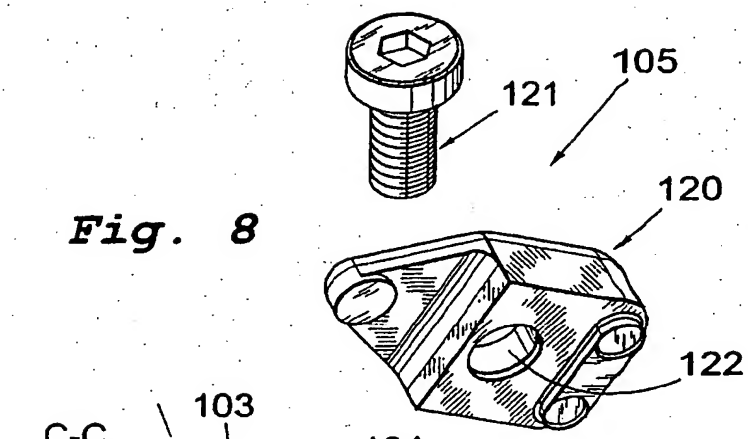

Fig. 8

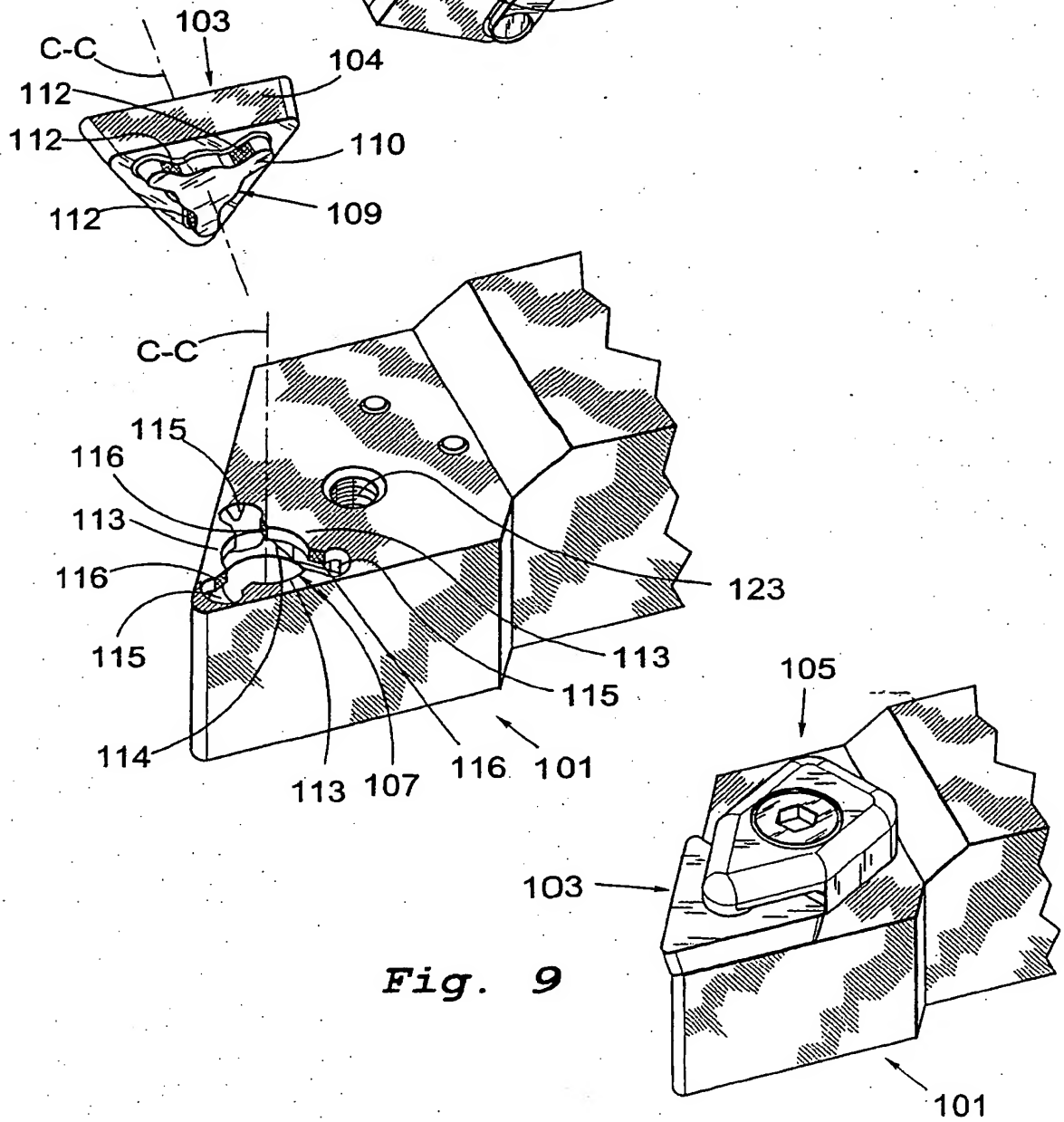

Fig. 9

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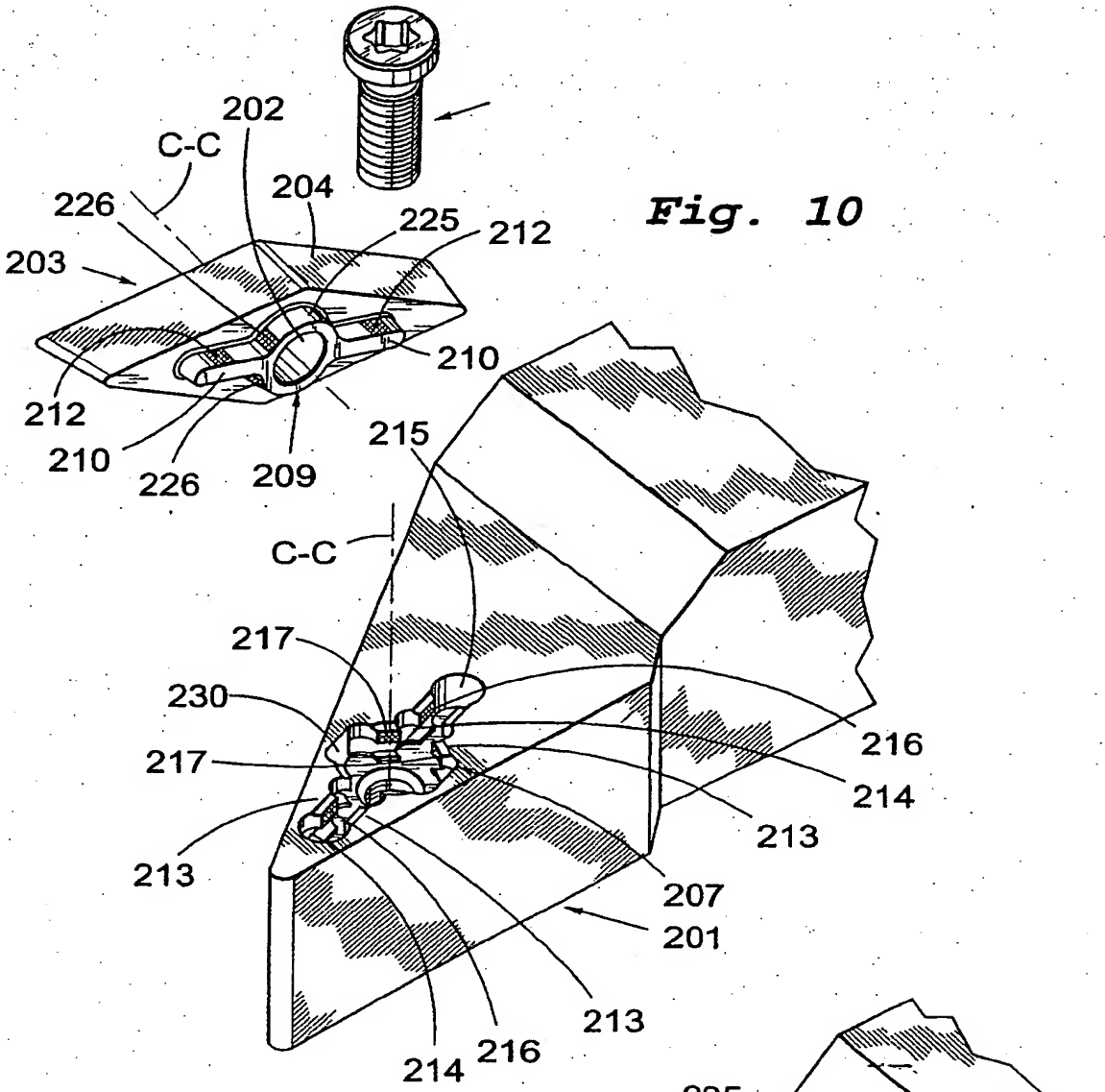

Fig. 10

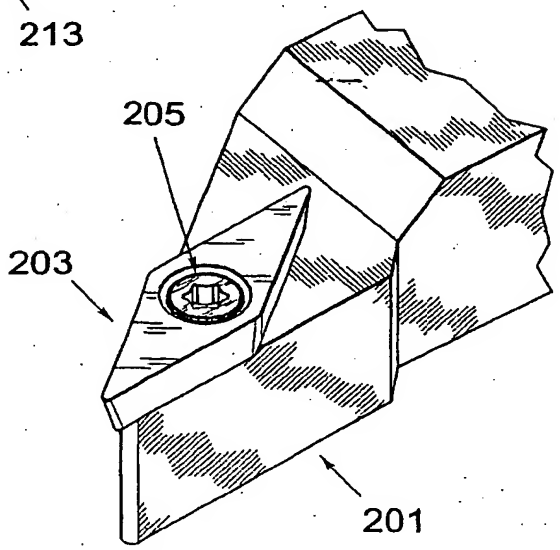

Fig. 11

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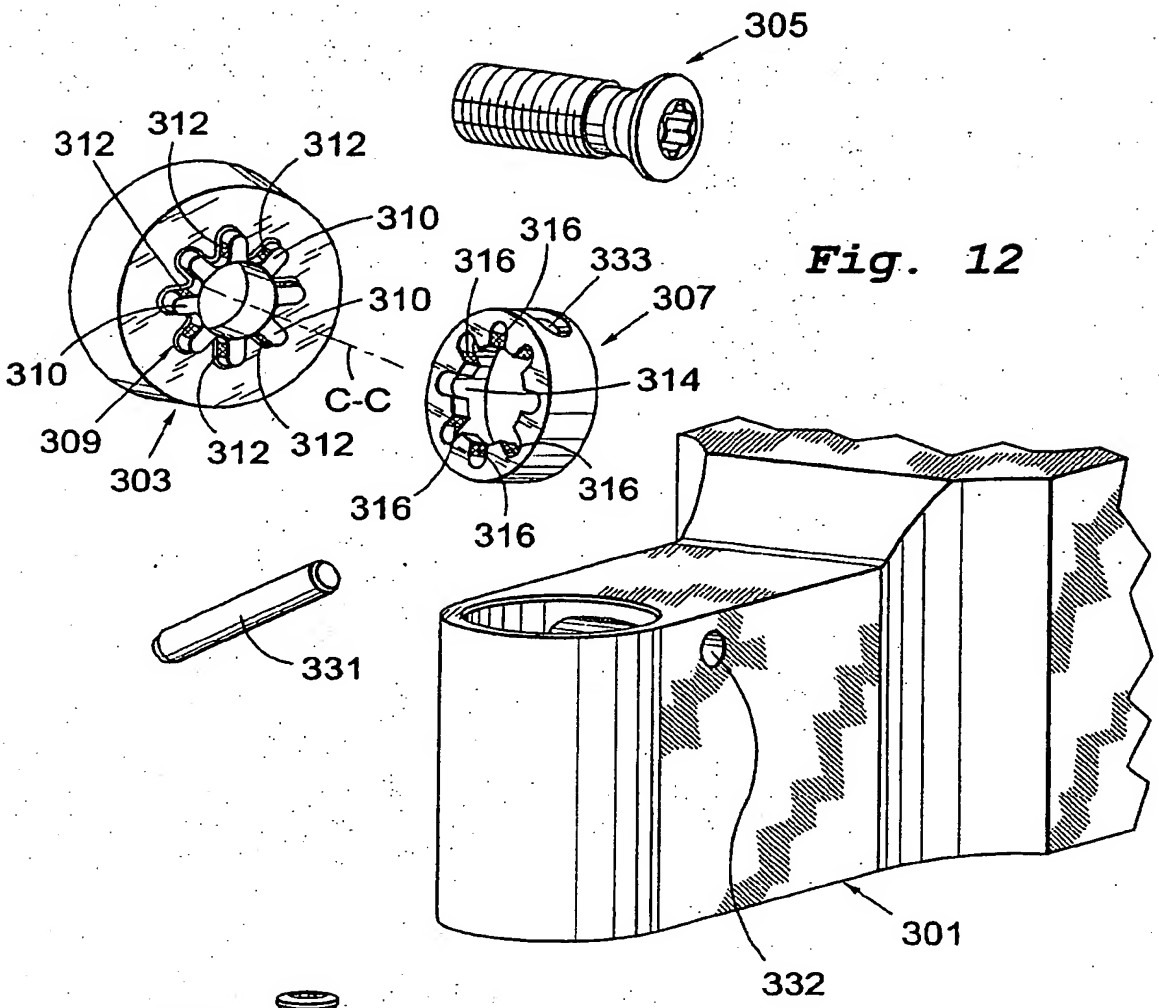

Fig. 12

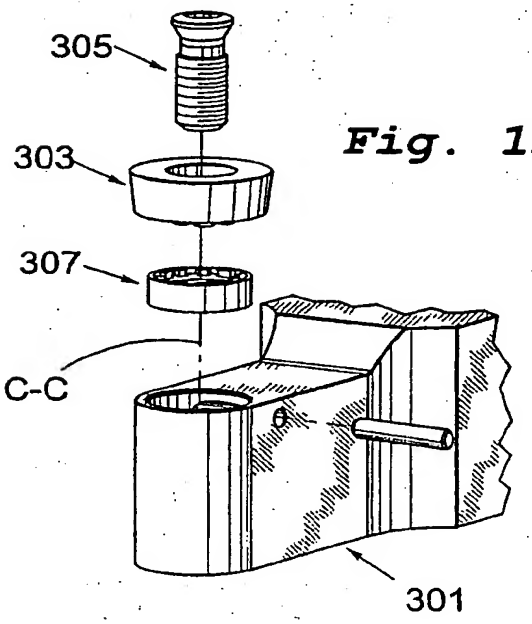

Fig. 13

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 44 5047

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	DE 198 47 227 A (WALTER AG) 20 April 2000 (2000-04-20)	1-4,6, 8-11	B23B27/00 B23B27/16
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Place of search	Date of completion of the search	Examiner
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